

latter case they would perhaps represent a *parasitic fungus*, certainly deviating from all at present known; in the former I do not know how to interpret them, except as *urticating organs*, which would exhibit an extremely remarkable agreement with the urticating organs of the Cœlenterata. Although I am inclined to the latter view, I would leave the decision to further investigations, which should be directed especially to the genesis of these bodies. If it should prove that these structures are really urticating organs belonging to the Vorticellan body, this would be of the greatest importance to our knowledge of the structure of the Infusorian body, as these urticating capsules, considering their perfect agreement with those of the Cœlenterata, would undoubtedly be developed, like the latter, *from cells*.

[To be continued.]

XXIII.—*On the Nomenclature of the Foraminifera.* By W. K. PARKER, F.R.S., and Prof. T. RUPERT JONES, F.G.S.

[Continued from vol. viii. p. 266.]

Part XV. *The Species figured by Ehrenberg.*

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§ 1. AMONGST the most enthusiastic observers and voluminous writers on Foraminifera Dr. Ch. G. Ehrenberg stands pre-eminent. By the end of the year 1838 he had reduced to order the multitudinous specimens of recent and fossil Microphytes and Microzoa which he had either gathered, with Dr. Hemprich, in the East or had received from numerous correspondents. Among the results is the Tabular Classification* of his BRYOZOA (*Polythalamia*, *Gymnocoræ*, *Thallopoda*, and *Sceleropodia*), which, mingling Foraminifera and Polyzoa,

* Table opposite p. 120, 'Abhandl.' für 1838.

could not greatly assist zoological investigations. Several beautiful figures are also given in the same volume of the Berlin Academy Transactions for 1838, of some recent Foraminifera, highly magnified (plates 1, 2, 3; see further on); and several samples of washed dust from various limestones and other fossil deposits are also figured on plate 4, magnified about 300 times linear. Some interesting conclusions were arrived at, valuable and true in the main:—namely, that the same kinds of Foraminifera (omitting all the other minute organisms, with which we do not now occupy ourselves) occur in both the fossil and recent state; but that at the same time each set of strata has more or less decidedly its own special group of Microzoa, and that Chalk in particular, and probably most limestones and calcareous marls, are largely composed of the shells of Foraminifera (*Polythalamia*, Ehr.), in some instances these minute organisms, with Coccoliths (Morpholites, Ehr., in part), appearing to be the main constituents of White Chalk.

The following year Dr. Ehrenberg studied some living Foraminifera of the North Sea at Cuxhaven; and he figured two of them (*Polystomella striatopunctata* and *Nonionina umbilicata*) with great exactness, as well as some obscurer forms, which he had found in both the living and the fossil state. (See further on.)

Amplifying with his own increased knowledge the already published observations on this subject of the persistence of low orders of life, Dr. Ehrenberg wrote the interesting memoir which appears, with the plates just mentioned, in the Berlin Acad. Transact. for 1839, and in Taylor's 'Scientific Memoirs,' vol. iii. art. XIII. Full illustrations of the numerous Foraminifera referred to, and their comparison with previously published species, were still wanting; and, as we shall have occasion to remark, the geological status of some of their sources was wrongly determined.

In 1843 several highly magnified figures of minute recent Foraminifera from America were treated of and illustrated by Ehrenberg in the Berlin Acad. Transact. for 1841, pp. 438 &c. Unfortunately, however, being merely views of microscopic objects seen by *transmitted light*, and therefore appearing merely as *sections*, or bare skeletons as it were, of the minutest* forms, little can really be learnt from them. (See further on,

* It is not, however, wholly on account of their minuteness that they are nearly useless to the zoologist, but for want of structural detail. Many minute Foraminifera are as good representatives of species and marked varieties as large specimens; for with arrested growth characteristic features are still preserved.

for an attempt to correlate them with known species and varieties.)

In the 'Abhandl. Berlin. Akad.' for 1847, pp. 442 &c., many extremely minute Foraminifera, occurring in Wind-dust on different occasions in several parts of Europe, form part of the curious gatherings of invisible things that wind-storms make and disperse in their whirlings over the surface of the earth—sweeping the sea-shore, sand-bank, and dry river-bed, the volcano, the desert, and the ploughed field, for organic and inorganic particles, and winnowing its dusty harvest over distant and far different areas. These tiny Foraminiferal waifs are still less teaching than those of 1841 as to genera and species, though they are potent witnesses of the path and doings of the wind-storm.

In 1854, however, the crowning of his favourite labour was accomplished for the Foraminifera, in the publication of Ehrenberg's 'Mikrogeologie,' with the recognition and aid of the State. In this grand work, besides multitudes of fossil Diatomaceæ, Polycystina, Spongoliths, &c., the long-looked-for Foraminifera were depicted with the best artistic skill, with loving care, and right royal liberality.

The late Mr. Thomas Weaver, F.R.S. &c., in the 'Annals and Magazine of Natural History,' vol. vii. (June 1841), pp. 296 &c., and (July) pp. 374 &c., and in the 'Philosoph. Mag.' ser. 3. vol. xviii. pp. 375 & 443, contributed a full abstract of two of Dr. Chr. G. Ehrenberg's memoirs—(1) On the Composition of Chalk Rocks and Chalk Marl by invisible Organic Bodies*, and (2) on the numerous Living Species of Animals found in the Chalk Formation†—together with an Appendix touching the Researches of M. Alcide D'Orbigny on the Foraminifera of the White Chalk of the Paris Basin‡.

Dr. Ehrenberg's memoir "On the muddy deposits at the mouths and deltas of various rivers in Northern Europe, and the Animalcules found in these deposits" (from the 'Abhandl.

* "Ueber die Bildung der Kreidefelsen und des Kreidemergels durch unsichtbare Organismen," Abhandl. Berliner Akad. Wissensch. für 1838, pp. 59–149, 4to, 1839.

† "Ueber noch zahlreich jetzt-lebende Thierarten der Kreidebildung," Abhandl. Berl. Akad. Wiss. für 1840, 4to, 1841. This memoir is translated in full, and illustrated with the original plates, in 'Taylor's Scientific Memoirs,' vol. iii. art. XIII. pp. 319 &c. plates v.–viii.

‡ Mémoires de la Soc. Géol. de France, vol. iv. 1^e partie, 1840. A notice of the Rev. W. Buckland's paper in the 'Edinb. New Phil. Journ.' April 1841, on the discovery of fossil Foraminifera in the Mountain-limestone of England, by MM. Tennant and Darker, in 1839, is also included in this Appendix by Mr. Weaver.

k. preuss. Akad. Wissensch. Berlin' for 1843) was noticed at large in the 'Quart. Journ. Geol. Soc.' vol. i. pp. 251 &c., as illustrative of the influence of microscopic life on recent and fossil stratified accumulations.

In these memoirs, and in shorter collateral notices in the 'Monatsberichte' of the Berlin Academy of Sciences*, Dr. Ehrenberg treated of numerous Diatomaceæ (Polygastrica), Polycystina, Foraminifera (Polythalamia), Spongoliths, and other microscopic organisms, which he had found, either recent, especially in the Red Sea, the Mediterranean, and the North Sea, or fossil in numerous deposits of various ages, such as the Mountain-limestone, Oolite, Chalk, Tertiary, and Posttertiary strata. Some few of the recent and fossil species were figured by him in the 'Abhandlungen' for 1838 and for 1839 (see pp. 218 & 221); but it was not until 1854 that Ehrenberg was enabled to fulfil his earnest and laudable desire to give to the world faithful and manifold portraits of the well-prepared and almost innumerable microscopic objects on which his published opinions had been founded. The second part † (middle third) of the magnificent folio volume entitled 'Mikrogeologie,' published under the patronage of Frederick-William the Fourth of Prussia, consists of 41 plates‡, illustrating the Microliths, Microphytes, and Microzoa to which his memoirs refer. Explanations of the plates, with a full index, are given, but no descriptive text; most of the specimens, however, are alluded to in other portions of the book, and in the 'Monatsberichte.'

On the Diatoms, Polycystines, Spongoliths, Geoliths, and Phytoliths here illustrated we do not offer any remarks; but we have busied ourselves with the beautiful engravings of the Foraminifera in the 'Mikrogeologie,' that we might bring

* Namely, Monatsb. für 1838, p. 104, flint from Volhynia; pp. 192-200, Microzoa mainly constituting Chalk; für 1840, pp. 18-23, Foraminifera of the North Sea; für 1844, pp. 74-96, new genera and species of Foraminifera; pp. 206, 207, Microzoa from the South-polar Sea; pp. 245-248, *Spirobotrys azea*; pp. 274, Microzoa from Kurdistan &c.; p. 414, Microzoa of the Chalk; für 1858, pp. 10-30, new genera and species from the Ægean and Mediterranean; pp. 118-128 and 295-311, siliceous casts of Foraminifera.

† The other parts of this grand work consist,—the first of catalogues, special and collective, of the microscopic objects, animate and inanimate, from 836 different freshwater deposits from all parts of the world, excepting North America; the third part contains notices of North-American microscopic life and microgeology, with special and collective catalogues of the objects found in upwards of 300 filterings, river-muds, and other deposits from the United States.

‡ Comprising four thousand figures, in great part coloured, and all (except in pl. 40) magnified at least 300 times linear.

them, with a corrected nomenclature, into correlation with the great mass of species and varieties, fossil and recent, now to be seen in numerous publications at home and abroad, and thus aid in working out the life-history of some, at least, of these remarkably persistent and widely diffused Protozoa.

It is difficult to follow Dr. Ehrenberg in his correlation of the several deposits from which he obtained the figured Foraminifera, because his identifications of Foraminiferal species and marked varieties are often incorrect, both among those of his own gathering and of these with such as had been figured or mentioned by D'Orbigny. And not merely are there difficulties as to *species*, but his generic groups are often discordant with the names they bear, and sometimes comprise two or more different genera (see Appendix). Nevertheless, taking a broad view of the results of his laborious, if not very discriminating, work among the recent and fossil Foraminifera, we may well congratulate him on having shown that several living species are also to be found fossil in Tertiary and Cretaceous deposits, though both his "species" and his geological conclusions are in many instances open to correction. Thus, throughout his interesting memoirs on the subject of the persistence of certain protozoan species, he uses the words "Chalk" and "Chalk-marl" for some *Tertiary* limestones and siliceo-calcareous earthy deposits; and, with respect to the zoological determinations of the Microzoa, we refer to the following observations on his figures and to the conclusions we arrive at concerning them, as showing the great discordance noticeable between his views and those of other rhizopodists. Yet throughout the work there truly appear numerous such persistent forms, belonging to the Cretaceous, Tertiary, and Recent periods, as his experienced eye really detected and in many instances his lists show, but which, for some occult reason, he failed generally to characterize by description and nomenclature, though often grouped naturally on his plates. As with his classification of the Foraminifera among his "Bryozoa" (1839)*, so with his 'Mikrogeologie' (1854), he failed to seize the clue to the right understanding and disentanglement of these many-featured Rhizopods. Ehrenberg's truthful plates, however, in the magnificent work last mentioned, supply the rhizopodist with a storehouse of beautifully prepared specimens, mostly seen by transmitted light, from various fossil deposits; and from these, for by far the most part, good and useful conclusions can be drawn, as from fresh specimens, except that, being viewed only in one manner (transparent),

* Abhandl. Berl. Akad. für 1838; Ann. & Mag. Nat. Hist. vol. vii. pp. 302, 303.

with but little perspective, and rarely with both faces of the shell, the student still finds himself too frequently at fault. The perfect engraving of shell-structure, tubes, pores, opacity, granulosity, &c., of septa, septal orifices in many cases, and other details, gives the majority of the figures great value; and, besides the evident truthfulness of form and structure, the picturing of accidental air-bubbles and contents of chambers (coloured sometimes) shows how exact and conscientious has been the artistic labour bestowed on the work.

In reading aright the generic and specific relations of Dr. Ehrenberg's Foraminifera, drawn so carefully in the splendid plates of the 'Mikrogeologic,' we have to remember that they are mounted in Canada balsam and seen by transmitted light; and, indeed, it requires an experienced acquaintance, almost if not quite as complete as that of Ehrenberg himself, with similarly mounted Foraminifera, from all parts of the world, to be enabled to detect and realize the zoological value of faint differences of apparent convexity and of opacity, punctation, porosity, and granulation, of relative thickness of shell-walls, which sometimes look like marginal keels,—of imperfect indications of the position, direction, and form of septal apertures, rarely shown except, as it were, in section,—and of other characteristic details which go to make the recognizable *facies* of a species or variety.

Few of the specimens figured are more than $\frac{1}{254}$ of a Paris line in diameter—that is, invisible to the naked eye. They are such as are readily washed away during the process of disintegrating soils, muds, and friable shales, marls, and chalk by means of water; whilst, on the contrary, such Foraminifera as have been figured by other authors are mostly those that remain after the muddy or chalky water has been poured off in the preparation, and can be readily picked out with the aid of a pocket-lens.

We cannot choose a better opportunity than the present to introduce the cordial and truthful expression of an accomplished American naturalist's well considered opinion of the great German microscopist's labours and expositions. Treating* of Ehrenberg's description of microscopic organisms from America, he says:—

"This important memoir by the illustrious Ehrenberg is characterized, like all the preceding works of this author, not

* Americ. Journ. Sc. Arts, vol. xlv. April 1844: Notice of a memoir by C. G. Ehrenberg, "On the Extent and Influence of Microscopic Life in North and South America," pp. 297–313.

only by marks of the most accurate research and indefatigable industry, but by the still higher merit of far-reaching philosophical views and a just appreciation of the important bearings and applications of the facts which he has brought to light."

With this eulogium we fully coincide, and feel certain that the better Ehrenberg's work is understood, the more will his beautiful and lasting illustrations, and his painstaking synoptical registers, advance the progress of biology in its relation to both the present and the past. In removing some obscurity from the highly valuable groups of Foraminifera of which he has treated, we shall be of use to naturalists and geologists, enabling them to put several extensive faunæ and local groups into close critical relation with each other and with such as have been observed by others. Further, we are sure that Ehrenberg himself, thinking over the improved biological systems of later naturalists, and open to conviction on good arguments, would freshly recognize the force of his own words respecting the importance of rhizopodal studies and their slowly progressive nature *, and be pleased to find, also, his own researches not only serving as a broad basis for the study in general and as steps to higher knowledge, but still more freely trodden in the upward ascent when made somewhat clearer and firmer for the student.

In 1847 Prof. W. C. Williamson†, F.R.S., had already taken in hand a survey of Dr. Ehrenberg's microscopical work in relation to the origin of limestones and some other rocks. Not merely as a reading critic, but as an original observer Prof. Williamson handled this subject in his masterly and systematic memoir, in which, escaping from some of Ehrenberg's biological errors, but still hampered by others, he first makes a review of his own collected materials—Desmids, Diatoms, Xanthids, Sponge-spicules, Foraminifera,

* *Op. cit.* p. 312. "From the rapid and great increase of the knowledge of an independent deep-working life in the smallest space, it follows that this field of research cannot be unworthy of the best efforts; and if it be not always equally and quickly productive, or if it may be more agreeable with easier speculation, and rather in poetic sport than seriously, to penetrate into the Remote, yet the only scientific and remunerating method is by slow and sure steps, and under the check of careful, and therefore laborious, research, to approach the goal which excites the minds of all thinking men of all generations, and will interest all generations yet to come."

† 'On some of the Microscopical Objects found in the Mud of the Levant, and other Deposits, with remarks on the Mode of Formation of Calcareous and Infusorial Siliceous Rocks.' 8vo, Manchester, 1847. (From vol. viii. of the Manchester Literary and Philos. Society's Memoirs.)

Polycystines (under the term "siliceous Infusoria"), shell-prisms, echinodermatal plates, &c. Secondly, he gives valuable notes on their distribution in the Levant, on the British coasts, in the West Indies, and elsewhere. Thirdly, their occurrence in the fossil strata of Barbadoes, Sicily, Paris, North and South America, and especially in the Chalk of Kent (Mr. Harris's collection), Yorkshire, Antrim, &c., the limestone of Lebanon, the Speeton Clay, Oolites, Lias, and the Mountain-limestone, with careful references to the labours of others, especially Ehrenberg and D'Orbigny. Fourthly, the origin of limestones, the manifold changes they have suffered, and silicification are his special objects of study; and, though doubtless Foraminifera are found to be the chief material of many limestones of very different ages, he warns his readers to be cautious in using these low and simple animalcules as exact criteria either for climates, depths, and regions, or for chronological succession. He critically applies the researches and statements of both Ehrenberg and D'Orbigny in support of this well-founded caution. Since 1847 few have laboured more than Williamson himself in clearing away the obscurities that beset the Foraminifera, enabling us to understand their genera, species, and varieties, to trace them through their species-life, and to compare them from remote strata and distant seas—and this with improved knowledge and far better results than fell to the lot of earlier observers.

We here refer the student to some careful drawings of Foraminifera from the Pacific, seen by *transmitted light*, and engraved in a former volume of the 'Ann. & Mag. Nat. Hist.' for comparison with those given by Ehrenberg. Among them are several of the species met with in the 'Mikrogeologie.' We have to correct the nomenclature used by the author.

J. D. Macdonald, "On Foraminifera from the Feejee Islands."
(Ann. Nat. Hist. ser. 2. vol. xx. pp. 193 &c. 1857.)

Pl. 5. figs. 1, 2. Doubtful. Figs. 3-5. *Polycystina*. From 1020 fathoms.

fig. 6. <i>Uvigerina pygmæa</i> , <i>D'Orb.</i> Dimorphous variety.	} From 440 fath.
figs. 7-10. <i>Lagena globosa et marginata</i> (<i>Montagu</i>). Entosolenian.	
figs. 11-14. <i>Globigerina bulloides</i> , <i>D'Orb.</i>	
fig. 15. <i>Planulina</i> ?	} From 1020 fath.
fig. 16. <i>Cymbalopora Poeyi</i> (<i>D'Orb.</i>).	
fig. 17. <i>Discorbina globularis</i> ? (<i>D'Orb.</i>). Young.	
figs. 18, 19. <i>Nonionina umbilicatula</i> (<i>Montagu</i>).	
fig. 20. <i>Discorbina globularis</i> ? (<i>D'Orb.</i>).	

Pl. 6. fig. 21. <i>Uvigerina pygmæa</i> , <i>D'Orb.</i> Aculeate variety.	}	From 1020 fath.
fig. 22. <i>Verneuilina pygmæa</i> (<i>Egger</i>).		
fig. 23. <i>Virgulina Schreibersii</i> , <i>Czizek</i> .		
fig. 24. <i>V. Schreibersii</i> (irregular and dwarf).		
fig. 25. <i>Discorbina Berthelotiana</i> (<i>D'Orb.</i>).		
fig. 26. <i>Textilaria pygmæa</i> , <i>D'Orb.</i> , <i>vel Bolivina punctata</i> , <i>D'Orb.</i>	}	From 440 fath.
fig. 27. <i>Bolivina punctata</i> , <i>D'Orb.</i> With an aculeate base.		
fig. 28. <i>Spiroloculina planulata</i> (<i>Lam.</i>).		
fig. 29. <i>Quinqueloculina seminulum</i> (<i>Linn.</i>). Young.		
fig. 30. <i>Triloculina oblonga</i> (<i>Montagu</i>).		
figs. 31, 33. <i>Calcarina Spengleri</i> (<i>Gmel.</i>), var.	}	Shallow water.
fig. 32. Described as a lenticular body, like a <i>Num- mulina</i> .		

Whatever the peduncles in figs. 31 & 33 may be, the terminal processes, referred to by Mr. Macdonald as peduncles, in figs. 2, 4, 6, 21, 23, & 30, are the usual more or less produced, tubular, stoloniferous apertures.

Several good *sectional views* of typical forms are given by Dr. J. G. Egger, 'Neues Jahrbuch für Mineralog. Geog.' &c. 1857, among his figures of the Miocene Foraminifera of Ortenberg; and these also may be advantageously used in comparison with Ehrenberg's figures.

§ 2. In the first place we propose to offer such conclusions as we think we can safely arrive at with respect to the figures of Foraminifera given in the 'Abhandlungen' for 1838, 1839, 1841, and 1847.

I. Abhandl. Berl. Akad. Wiss. für 1838 (1839), pp. 54-149, with table and 4 plates. (Ueber die Bildung der Kreidefelsen und des Kreidemergels durch unsichtbare Organismen.)

Pl. 1. fig. 1, A, *a*, *** &c., B, *a, b, c, d, e*, &c. *Rotalia Beccarii*. From the Adriatic. = *R. Beccarii*, var. *ammoniformis* (Lin. et Lam.).

fig. 2. A, *α, a, b, c*, B. *Marginulina raphanus* [Linn. sp.]. From Rimini, Adriatic.

Pl. 2. fig. 1, *a, b, c, d, x, y*, &c. *Peneroplis planatus*. From the Red Sea. = *P. pertusus* (Forskål).

fig. 2, *a, b, α, x*, &c. *Coscinospira** *Hemprichii*. From the Red Sea and Libyan portion of the Mediterranean. The elongate subtype of *Peneroplis*.

Pl. 3. fig. 1, *a, b, c, d*, &c. *Orbiculina numismalis* [Lamarek].

* This subgeneric name (= *Spirolina*, Lamarek) is misapplied to the elongate *Lituolæ* in some of Dr. Ehrenberg's memoirs.

From the Antilles. = *Orb. adunca*, and var. *orbiculus* (F. & M.).

fig. 2, *a, b, c, d.* *Sorites orbiculus*. From the Red Sea and Mediterranean. Young stage of *Orbitolites orbiculus* (Forskål).

fig. 3. *Amphisorus Hemprichii*. From the Red Sea? Old condition of the same.

Pl. 4. fig. 1. "Writing Chalk," from Puzskary, Poland; opposite Grodno, on the Memel.

fig. 2. The same, from Jutland, Denmark.

fig. 3. The same, from Rügen Island, Pomerania.

fig. 4. The same, from Gravesend, on the Thames.

fig. 5. The same, from Meudon, near Paris.

fig. 6. "Harder writing Chalk," from Cattolica, Sicily.

fig. 7. "Compact Chalk," from Cahira, Mokattam Hills, near Cairo.

fig. 8. The same, from the catacombs of Thebes, Upper Egypt.

fig. 9. "Compact grey limestone," from Hamam Farāun (Mountain), Sinai, Arabia.

fig. 10. "Chalk-marl," from Oran, Africa.

fig. 11. The same, from Caltanissetta, Sicily.

fig. 12. The same, from Greece.

These are samples of the limestones or marly earths*, finely levigated, showing the Microzoa &c. of which they are severally composed, highly magnified, and few exceeding $\frac{1}{44}$ of a (Paris) line in diameter.

The following list comprises the Foraminifera figured in plate 4, as named in the memoir:—

Globigerina bulloides (?), <i>D' Orb.</i>	<i>Rotalia perforata</i> .
— helicina (?), <i>D' Orb.</i>	— scabra.
Planulina sicula.	— stigma.
— turgida†.	Textularia aciculata (?), <i>D' Orb.</i>
Robulina cretacea.	— aspera†.
Rosalina foveolata†.	— brevis.
— globularis (?), <i>D' Orb.</i>	— dilatata†.
— lævigata†.	— globulosa†.
— pertusa.	— perforata.
Rotalia globulosa†.	— spinosa.
— ocellata.	— striata†.
— ornata.	Turbinulina italica (?), <i>D' Orb.</i>

Excepting those from Poland, all the above and many

* The first six and the eighth are "chalk" or "chalk-marl," or, rather, cretaceous limestones; 10 & 11 are white siliceo-calcareous earths, composed of Diatoms and Polycystines, with relatively few Foraminifera; and 12 is argillaceous.

† These are the most abundant.

others are better figured and determined in the 'Mikrogeologie,' 1854.

The species of Foraminifera known to Ehrenberg in 1839 are enumerated and characterized at pp. 130-135, Abhandl. für 1838.

II. Abhandl. Berl. Akad. für 1839 (1841), pp. 94 *et seq.*, with 4 plates. (Ueber noch zahlreich jetzt-lebende Thierarten der Kreidebildung.)

Pl. 1. fig. 1, *a-g*. *Geoponus stella-borealis* *. = *Polystomella striatopunctata* (F. & M.).

Pl. 2. fig. 1, *a-g*. *Nonionina germanica* *. = *Nonionina umbilicatulata* (Montagu).

fig. 2, *a, b, c*. *Rotalia perforata*. = *Planorbulina*.

fig. 3, *a, b*. ——— *globosa*. = *Planorbulina*?

fig. 4, *a, b*. ——— *turgida*. = *Cristellaria rotulata* (Lamarck).

fig. 5, *a, b*. *Textilaria aciculata*. = *Bolivina dilatata* (?), Rss.

III. Abhandl. Berl. Akad. Wiss. für 1841 (1843). (Verbreitung und Einfluss des mikroskopischen Lebens in Süd- und Nord-Amerika.)

P. 438, pl. 1. fig. 31. *Rotalia peruviana*. = *Pulvinulina*?

P. 441 (from Cuba), pl. 2. fig. 39. *Triloculina antillarum*. = *Miliola* (*Quinqueloculina*?).

fig. 40. *Triloculina turgida*. = *Uniloculina*?

fig. 41. *Rotalia perforata*. = *Planorbulina*? vel ?*Discorbina globularis*? (D'Orb.).

fig. 42. *Rotalia cochlea*. } = *Pulvinulina cultrata*?

fig. 43. *Rotalia egena*. } (D'Orb.).

fig. 44. *Textilaria semipunctata*. = *Bolivina*?

P. 443 (from Vera Cruz), pl. 3. fig. 41. ?*Spirillina vivipara*. This is stated to be *siliceous*; but it is extremely like some of the simply tubular, non-segmented *Pulvinulinae*, and has been taken as a subtype. In the 'Mikrogeologie,' at p. 3 and elsewhere, in the lists of Microzoa, a *calcareous Spirillina vulgaris*, Ehr., is mentioned; but whether this is a relation of *Pulvinulina*, or a *Cornuspira*, or a *Trochammina*†, we have no means of judging.

* These two species are described in the Monatsber. for 1840, p. 23.

† The group of unchambered shells for which *Sp. vivipara* was taken as a type by one of us in 1850 (in King's "Monograph of Permian Fossils," Palæontogr. Soc. pp. 18-20) has been divided into the three divisions above indicated. The Permian discoidal fossil is really a *Trochammina*; but, from its supposed relationship to the Bordeaux fossil (a real

- fig. 42. *Spiroloculina lagenae*. = *Miliola*.
 fig. 43. ? *Planularia pelagi*. = *Pulvinulina auricula*?
 (F. & M.)
 fig. 44. *Textilaria ocellata*. = *Bolivina dilatata*, Rss.
 fig. 45. *Grammostomum tenue*. = *Virgulina Schreibersii*,
 Czjz.
 fig. 46. *Text. stichopora*. = *Textilaria sagittula*?, Defr.
 fig. 47. ? *Cristellaria vitrea*. = *Rotalia orbicularis*, D'Orb.
 (Vitreous variety of *R. Beccarii*.)
 fig. 48. *Planulina tenuis*. = *Planorbulina*?
 fig. 49. *Allothea megathyra*. = *Planorbulina farcta*;
 young, with coarse pores.
 fig. 50. *Nonionina millepora*. = *Nonionina*.
 fig. 51. *Ptygostomum oligoporum*. = *Planorbulina*?

IV. Abhandl. Berl. Akad. für 1847 (1849). (Passatstaub und Blutregen.)

P. 443. (Wind-dust, Italy.)

Pl. 1. fig. 95. *Spiroloculina*? Young *Miliola*?

fig. 96. Fragment.

fig. 97. *Rotalia globulosa*? Fragment. ?

fig. 98. *R. senaria*? Fragment. ?

P. 445. (Wind-dust, Calabria.)

Pl. 1. fig. 109. *Miliola*? (*Oolina*?) ?(Not *Miliola*.)

fig. 110. Fragment.

P. 446. (Wind-dust, Malta.)

Pl. 2. fig. 77. *Textilaria striata*. *Textilaria gibbosa* (?),
 D'Orb.

figs. 78, 79. *T. globulosa*. Fig. 78, *T. globulosa*, Ehr.,
 and fig. 79, *T. carinata*, D'Orb.

fig. 80. *Grammostomum*. *T. agglutinans*, D'Orb.

fig. 81. *Gr. carinatum*? *Bolivina costata* (?), D'Orb.

fig. 82. *Spirillina*. Young *Cornuspira*? or *Miliola*.

fig. 83. *Rotalia*? ?

fig. 84. *R. globulosa*. ?

fig. 85. *R. senaria*. ?

P. 456. (Wind-dust, Lyons.)

Pl. 5. fig. 108. *Nodosaria*? ?

fig. 111. *Textilaria globulosa*. *T. globulosa*, Ehr.

figs. 112, 113. *Rotalia globulosa*? ?

fig. 114. *Rotalia*. ?

Spirillina of the *Pulvinulina* family) mentioned at p. 19, much confusion arose, which was not cleared quite away until the three kinds of discoidal unchambered Foraminifera were recognized. See Ann. Nat. Hist. ser. 4. vol. iv. pp. 386 &c.

P. 457. (Wind-dust, Paster-Thal.)

Pl. 6 I. figs. 82, 83. Spiroloculina. Young *Cornuspira*? or *Miliola*?

P. 460. (Wind-dust, Silesia and Austria.)

Pl. 6 III. fig. 59. Textilaria globulosa? *T. gibbosa*, D'Orb.
fig. 80. Textilaria globulosa? *T. globulosa*, Ehr.

§ 3. We now proceed to study the 'Mikrogeologie' (1854), beginning with the first plate that contains figures of Foraminifera.

I. *Marl* [?], or clay from *Ægina*, Greece. ("Plastischer Thon" in the explanation of the plate; "Mergel-Fels. als plastischer Thon. aus *Ægina*" on the plate.) (Abhandlungen der Berliner Akademie der Wissenschaften, 1838; Griechenland no. 5. Monatsberichte Berl. Ak. Wiss. 1838, p. 176; 1842; 1844, pp. 62, 73, &c.; 1847, p. 43.)

This certainly appears to be a Tertiary* clay containing Diatoms, spicules, and Polycystines in abundance, and with so little calcareous matter (*Foraminifera*) that it can be used for terra cotta. Its position is thus described by Herr Fiedler in Dr. Ehrenberg's memoir:—"Ueber einen plastischen Kreidemergel von *Ægina* aus mikroskopischen Organismen und über die möglichkeit, durch mikroskopische Untersuchung des Materials den Ursprung gewisser alter ächtgriechischer Kunstdenkmäler aus gebrannter Erde (Terracotten) mit bisher unbekannter Sicherheit zu bestimmen." (Monatsber. 1842, pp. 263-268.)

"In *Ægina* there is much chalk-marl [?], particularly in the valley north of the town. A little peaked hill in the middle of the valley, on which stands a small chapel to St. Demetrios, is overlain by pale-red trachyte two fathoms thick; under this, down to the base, the hill consists of yellowish-white and greyish chalk-marl [?]. The upper, yellowish marl contains *Venus* shells; the lower, pale-pellow marl, with greenish streaks, has *Pecten* shells and rusty specks, and there only is soft to the nail. This lower portion in particular forms (*bildet*) a plastic clay which is worked" (p. 263).

Clays rich in Diatoms have been used for brick-making and ceramic purposes in England, Europe, Asia, and North America.

Plate xix. figs. 1-80 comprehend Diatomaceæ, Polycystina, Spongoliths, &c. Fig. 81, *Nodosaria monile* (1844, p. 93), is *N. filiformis*, D'Orb. Fig. 82, *Grammostomum depressum*

* It is referred to as of Tertiary age by Ehrenberg, 'Abhandlungen,' 1856, p. 127.

(1844, p. 93), is a short stout *Textilaria gibbosa*, showing a tendency towards *T. subangulata*, D'O. Fig. 83, *Gr. laterale* (1844, p. 92), is a neat, small, and rather broad *Bolivina punctata*. Fig. 84, *Gr. polystigma* (1844, p. 92), is a very fine large typical *Bolivina punctata*. Fig. 85, *Polymorphina* (?) *aculeata* (1844, p. 94), is *Bulimina aculeata*, D'Orb. Fig. 86, *Strophoconus græcus* ("1844, p. 96; *Textilaria aciculata*?, 1838"), seems to be either *Virgulina Schreibersii*, or, from its shell-structure, perhaps *Virgulina Hemprichii* (Ehr.), see 'Geol. Mag.' no. 89, p. 509. Fig. 87, *Rotalia Pandoræ* (1844, p. 95), is probably a small *Planorbulina*. Fig. 88, *R. umbilicus* (1844, p. 95), is also doubtful; it looks like some variety of *Planorbulina*. Fig. 89, *R. globulosa*, α (1838), is a young *Globigerina*. Fig. 90, *R. senaria* (1842), also is probably a young *Globigerina*. Fig. 91, *R. lepidæ* (1844, p. 95), seems to be a small *Planulina ariminensis* (?). Fig. 92, *Globigerina depressa* (1844, p. 92), is a good *G. bulloides*. Fig. 93, *Planulina elegans* (1844, p. 93), is a neat, delicate, sub-lobate *Planorbulina* of the *Haidingerii* subtype. Fig. 94, *Planulina globularis* (1844, p. 94), and 95, *Pl. porosa* (1844, p. 94), are two small, but neatly grown, specimens of a variety of *Planorbulina farcta*, near var. *Haidingerii*, but limbate on the margins and septa. It is the larger stage of *Pl. globulosa* (Ehr.). Fig. 96, *Planulina vitrea* (1844, p. 94), a young delicate individual of *Planorbulina Haidingerii*. Fig. 97, *Spiroloculina elongata* (1844, p. 96), a rather narrow form of *Sp. planulata*, Lamk.

The *facies* is that of a fauna from between 50 and 90 fathoms depth. Too many forms are present for an abyssal fauna.

Species and noticeable Varieties from Ægina (No. 1), figured by Ehrenberg.

1. *Nodosaria filiformis*, D'Orb.
2. *Bulimina aculeata*, D'Orb.
3. *Bolivina punctata*, D'Orb.
4. *Virgulina Schreibersii* (?), Czjzek.
5. *Textilaria gibbosa*, D'Orb.
6. *Globigerina bulloides*, D'Orb.
7. *Planorbulina Haidingerii* (D'Orb.).
8. — *globulosa** (Ehr.).
9. *Planulina ariminensis* (?), D'Orb.
10. *Spiroloculina planulata* (Lamarck).

* This must not be regarded as a species of real worth; for the young of *Planorbulina Haidingerii*, *Pl. vulgaris*, *Pl. lobatula*, and *Pl. ariminensis* are almost indeterminable one from another and from young *Nonioninæ*, especially when seen by transmitted light. Further, Ehrenberg's "*Rotalia globulosa*" not only comprises the above, but small *Globigerinæ* also.

II. *Laminated Marl*[?], or *marl-like Diatom-earth* ("Platten-Mergel, Placca di Furni, Plocafurno") from Zante, Greece. Composed largely of Diatoms and Polycystines. (Monatsber. Berl. Akad. Wiss. 1837, p. 61 : 1839. Abhandlung. Berl. Akad. 1838, Tabelle.)

Plate xx. I. figs. 1-53. Diatomaceæ, Polycystina, Spongolithi, &c.

Figs. 54, *Rotalia globulosa*, β ? (1838), and 55, *R. senaria*, are probably young *Planorbulina* (*Pl. globulosa*?). Fig. 56, *Planulina annulosa*, looks like a small *Pl. ariminensis*, but it may be a *Nonionina* (?).

Species and noticeable Varieties from Zante figured by Ehrenberg.

1. *Planorbulina farcta* (F. & M.), var. *globulosa* (Ehr.).
2. *Planulina vel Nonionina*?

III. *Non-plastic marl from Ægina, Greece.* (Monatsb. Berl. Akad. 1838, p. 176. Abhandl. Akad. 1838, Tabelle, Griechenland no. 4.)

The specimen yielding the Microzoa here figured was a slightly plastic calcareous clay (marl) of Tertiary age, from the bed lying immediately on the plastic clay in the same hill in Ægina. In it Foraminifera predominate, and Diatoms and spicules are relatively few; and it differs so much in its organic contents that Ehrenberg thought it must be Tertiary, whilst he assigned the lower bed to the Cretaceous series, like those siliceo-calcareous deposits from Sicily and Oran * described by him (erroneously) as "Chalkmarls."

Pl. xx. II. fig. 1, *Nodosaria monile*, = *N. filiformis*, D'Orb. Figs. 2, *Strophoconus auricula*, 3, *St. ovum*, and 4, *St. gibbus*, are small specimens of *Virgulina Schreibersii*; and 5, *St. gemma*, is another, but varietal, approaching *Bulimina elegantissima* in its mode of growth. Fig. 6, *Spiroloculina tenera*; a small *Adelosina*, or first stage of nearly any *Miliola*. Fig. 7, *Grammostomum elegans*, is a delicate, rather broad, and partially punctate *Bolivina punctata*. Fig. 8, *Proroporus argus*, is a fine, strong, thick-shelled, short-chambered, and coarsely perforate variety of *B. punctata*. Fig. 9, *Gr. sulcatum*, is *B. costata*, or rather a delicate subvariety, neatly marked with slight furrows. Fig. 10, *Gr. aciculatum* ("Textilaria aci-

* The Microzoa of the lower plastic clay bed are compared with those of Caltanissetta and Oran, in a synoptical table, under revised names, in the 'Monatsbericht,' 1844, the Foraminifera at p. 44.

culata, 1838"), is a small *Bolivina dilatata*, Reuss (Denkschr. k. Akad. Wiss. Wien, 1850, pl. 48. f. 15); for a larger specimen see Mikrogeol. pl. 29. f. 23 (from Moen). Fig. 11, *Rotalia Pandoræ* (?), a small *Planorbulina* (?). Figs. 12, *a, b*, and 14 *a*, *R. globulosa*, 14 *b*, *R. senaria*, are probably minute *Planorbuline* (*Pl. globulosa*). Fig. 13, *a, b*, *R. umbilicus*, are larger, but still small, *Planorbuline*. Fig. 15, *Globigerina* (?), is a well-grown *Gl. bulloides*. Fig. 16, *Planulina proroteras*, = young *Gl. bulloides*. Fig. 17, *Pl. fumigata*, is the same as fig. 93 in pl. xix., but shows the opposite face,—a delicate *Pl. Haidingerii*, with subglobose inflated chambers. Fig. 18, *Pl. denticulata*, and fig. 19, *Pl. porosa*, is an interesting variety of *Planorbulina farcta*, such as is not rare in some seas, having a rough or aculeate shell, with thickened or limbate margin. These are variable characters in this very common species. Figs. 20, *Pl. adspersa*, 21 *a*, *Pl. turgida*, and 21 *b*, *Pl. annulosa*, are various small *Planorbuline* (fig. 21 *a* may be *Planulina ariminensis*). Fig. 22, *Pl. sparsipora*, is *Rotalia orbicularis*, seen with its flat face upwards: it has a clear colourless shell, with very fine pores. The few holes shown in the figure are perhaps borings. Fig. 23, *Pl. stellaris*, is a young, close-built *Planorbulina Haidingerii*, with some more limbation than usual. Fig. 24, *Robulina cristellina*, looks like a delicate *Cristellaria rotulata*. Fig. 25, *Cristellaria incrassata*, is a strongly limbate *C. cultrata*.

Belonging to a fauna inhabiting from about 50 to 90 fathoms depth.

Species and noticeable Varieties from Ægina (No. 2)
figured by Ehrenberg.

1. *Nodosaria filiformis*, *D' Orb.*
2. *Cristellaria rotulata* (*Lamk.*).
3. — *cultrata* (*Mtft.*).
4. *Bolivina punctata*, *D' Orb.*
5. — *argus* (*Ehr.*).
6. — *sulcata* (*Ehr.*).
7. — *dilatata*, *Rss.*
8. *Virgulina Schreibersii*, *Czjzek.*
9. — *gemma* (*Ehr.*).
10. *Globigerina bulloides*, *D' Orb.*
11. *Planorbulina Haidingerii* (*D' Orb.*).
12. — *denticulata* (*Ehr.*).
13. — *globulosa* (*Ehr.*).
14. *Planulina ariminensis* (?), *D' Orb.*
15. *Rotalia orbicularis*, *D' Orb.*
16. *Miliola* (young).

IV. The deposit that yielded the Diatomaceæ ("Polygastrica," Ehr.) and Foraminifera figured in plate xxi. was a white finely laminated calcareous and diatomaceous deposit containing numerous well-preserved impressions of fishes. This so-called "marl," also termed "Infusoria-conglomerate," "Tripoli-marl," and "Tripoli" by Ehrenberg, was found by M. Rozet, as two layers, with some calcareous and sandy beds, containing *Ostreæ* and *Gryphææ*, between them; and all of them occur among white chalk-like limestones and yellowish marls, with *Ostreæ* &c., in the plain east of Oran and extending to the Atlas. M. Rozet regarded these deposits as of Tertiary age; but Dr. Ehrenberg referred them to the Cretaceous series, on account of his determination of the same kinds of "Polygastrica" and "Polythalamia" in them as in other beds regarded by him as Cretaceous. He considers this Oran Tripoli to be equivalent to a similar white diatomaceous and calcareous earthy bed, with fish-remains, that is found in Sicily (see further on). This latter deposit is characterized by *Clupea tenuissima*, and, like that of Oran, has been classified among the Tertiary formations; nor does there appear any valid reason, based on its Microzoa, to group it otherwise.

Shaly Tripoli-bed, from Oran, Africa. Abounding with Diatoms and Polycystines. (Abhandl. Berl. Akad. Wiss. 1838, table no. 4, and fig. x. Monatsber. 1840; 1844, pp. 62, 73, &c. Ann. Nat. Hist. vol. vii. p. 312.)

Plate xxi. figs. 1-81 comprise Diatomaceæ, Polycystina, Spongoliths, &c.

Fig. 82, *Grammostomum cribrum* (1844, pp. 67, 93), = *Bolivina dilatata*. Fig. 83, *Proroporus lingua* (1844, pp. 67, 95), = *Bol. punctata*, with slight indications of ribbing, and therein approaching to *costata*. Fig. 84, *Gr. plica* (1844, pp. 67, 93), and fig. 85, *Gr. aciculatum* (1844), are *Bol. punctata*. Fig. 86, *Gr. divergens* (1844, pp. 67, 93), = *B. dilatata*. Fig. 87, *Textilaria globulosa* (1844), is a small *T. gibbosa*. Fig. 88, *Strophoconus africanus* (1844, pp. 68, 96), is a young *Virgulina Hemprichii*. Fig. 89, *Planulina perforata* (1844), fig. 90 *a, b*, *Rotalia globulosa* (1838, 1844), and fig. 91, *Pl. ocellata* (1844, p. 67), are young individuals of *Globigerina bulloides*. Fig. 92, *Prorospira princeps* ("1844, pp. 67, 95, = *Planulina turgida*, 1844, young"), = *Planorbulina ammonoides*. Fig. 93, *Pr. comes* (1844, pp. 67, 95), is a variety near *Pl. ammonoides*. Fig. 94, *Planulina squamula* (1844, pp. 67, 94), is a small limbate *Planorbulina*. Fig. 95, *Pl. spatiosa*, is a large, broad-

topped, gently sculptured, glassy, flat *Pulvinulina*, so much coated with clear secondary shell-deposit as to have the fine pores masked. It is near var. *pulchella* of *Pulv. repanda*. Ehrenberg has figured it also from the Chalk of Moën (pl. 29. fig. 15), and a very close ally from that of Rügen (pl. 30. fig. 28). Fig. 96, *Globigerina foveolata* (1844, p. 67), is *Gl. bulloides*. Fig. 97, *a, b. Nodosaria*? These are single and double rough-coated hollow globules, possibly chambers of *Globigerina* (?), but not of *Nodosaria*.

Inhabiting a depth of from 40 to 50 fathoms.

*Species and noticeable Varieties from Oran, figured by
Ehrenberg.*

1. *Bolivina punctata*, *D' Orb.*
2. ——— *dilatata*, *Rss.*
3. *Virgulina Hemprichii* (*Ehr.*).
4. *Textilaria gibbosa*, *D' Orb.*
5. *Globigerina bulloides*, *D' Orb.*
6. *Planorbulina ammonoides* (*Rss.*).
7. *Pulvinulina spatiosa* (*Ehr.*).

V. The deposit yielding the Microzoa figured in pl. xxii. is described as a white, chalk-like, thinly laminated "marl," analogous to tripoli, from Caltanisetta, in Sicily. It was obtained by the late Mr. Hoffmann; and in his MSS. it was termed "white chalkmarl," and referred to the Cretaceous rocks dipping at a high angle below unconformable Tertiary deposits. Ehrenberg, however, identifies these laminated marly beds, containing numerous fishes, found between Caltanisetta and Castrogiovanni, near the middle of Sicily, with the diatomaceous earth from near Oran, above treated of. Between the two Sicilian localities mentioned above, Cretaceous rocks certainly are exposed; but others of Tertiary age also abound, including, we believe, the diatomaceous calcareous earth, with *Chupea tenuissima*, already referred to; and if this white earthy siliceo-calcareous deposit (which is not a "marl" in the correct sense), abounding with *Coscinodisci* and *Globigerina**, be the same as that to which Ehrenberg alludes, there is no doubt of its *Tertiary* age.

White Chalky Marl [?] of Caltanisetta, Sicily. (Abhand. Berl. Akad. Wiss. 1838, pl. 4. fig. xi. Monatsb. 1840, 1844. Ann. Nat. Hist. vii. p. 313.)

Pl. xxii. figs. 1-73. Diatomaceæ, Polycystina, Spongo-liths, &c.

* We have some of this rock, from Sicily, in our own collection.

Fig. 74, *Globigerina foveolata* (1844, p. 67), a large and characteristic *Gl. bulloides*. Fig. 75, *Planulina pertusa* (1844, p. 67), fig. 77, *Pl. stigma* (1844, p. 67), and fig. 78, *Rotalia globulosa* (1838; 1844, p. 67), are young *Globigerinae*. Fig. 76, *Colpopleura ocellata* ("1844, pp. 67, 92; *Rotalia ocellata*, 1838") is a variety of *Planorbulina farcta*, very near to *Haidingerii*, with very large irregular holes. Fig. 79, *Rotalia scabra* (1844, p. 67), a very coarse-shelled variety of *Pl. farcta*, of the *ammonoides* group. Fig. 80, *Textilaria perforata* (1844, p. 68), obscure; possibly an unusually perforate young *Textilaria* with globose chambers, but probably an irregularly grown *Globigerina*. Fig. 81, *Strophoconus ovum* (1844, p. 96), is a young *Virgulina Schreibersii*.

These represent a fauna that lived at not less than 100 fathoms.

Species and noticeable Varieties from Caltanisetta, figured by Ehrenberg.

1. *Virgulina Schreibersii*, Czjzek.
2. *Textilaria*?
3. *Globigerina bulloides*, D' Orb.
4. *Planorbulina Haidingerii* (D' Orb.).
5. — *ammonoides*? (Rss.).

VI. The Nummulitic Limestone of Egypt has been regarded as of Tertiary age by geologists since the determination of its Eocene characteristics by the late lamented Sir Roderick Murchison, in his memoir on the Alps and Carpathians, &c. Quart. Journ. Geol. Soc. 1849, vol. v. p. 303. It had previously been looked on as of Cretaceous age; and Ehrenberg, in the 'Mikrogeologie,' speaks of it as belonging to that period, on the ground of his finding Cretaceous Foraminifera in it. His figures do not bear evidence of this in a special manner; indeed the *Nummulinae* are preeminently "Tertiary," none being known in the Chalk of Europe, and only a few specimens of *Operculina**, their nearest ally. A doubtful *Nummulina*, *N. cretacea*, Fraas†, has been recorded as belonging to the Hippurite (Cretaceous) Limestone of Palestine, near Jerusalem; and with this feeble link (strengthened by other considerations) it may be said that there may be some Nummulite-bearing rocks transitional from the Chalk series to the Eocene. Those of Egypt, however, are markedly Eocene.

* *Operculina Fleuriusi* (Rss.); *Op. cretacea*, Rss.; *Op. clypeolus* (Rss.); *Op. angularis*, Cornuel; *Op. turgida* (Ehr.).

† 'Aus dem Orient,' 1867, pl. 1. fig. 8.

The specimens of limestone analyzed by Dr. Ehrenberg were brought from Gyzeh, on the left bank of the Nile, and from Mokattam, near Cairo, on the right bank. It was compact, the small Foraminifera serving as cementing-matter among the Nummulites of which the rock is mainly composed.

The figured Foraminifera of plate xxiii. bear evidence, in the truthful engraving of their somewhat rough, partly obscured, and occasionally broken condition, to their having been closely cemented and much mineralized by carbonate of lime in their fossil matrix.

[To be continued.]

XXIV.—*On some Recent Researches in Vegetable Physiology.*
By M. MARC MICHELI.

[Continued from p. 155, and concluded.]

II.

THE study of the phenomena of which the interior of cells is exclusively the theatre, of the transformations which are manifested there, and of the substances which they contain has also produced some works which deserve notice, and in the first place the researches of M. Schröder* upon the "spring period of the maple." The author has paid attention to all the successive phases presented by the development of the vegetation, from the ascent of the sap to the moment when the expanded leaves begin to decompose carbonic acid. This is one of those complete and conscientious works which, even when they do not contain any very novel results, are nevertheless very useful to read and consult; but it is difficult to give a clear notion of them in a few words.

A glance at the course followed by M. Schroeder will show the great number of facts which group themselves within a framework such as he has adopted.

The first part is entirely devoted to the study of the sap, its ascent, and its composition. The maple, under the latitude of Breslau, "*weeps*" for about a month; the sap rises gradually to a certain level, whence it descends again by degrees, in proportion as the development advances. Holes pierced in the trunk at different heights enabled this sap to be collected daily; and very numerous analyses keep us informed of the smallest variations in its composition. It always contains sugar, a transitory product of the transformation of the starch accumulated in the tissues during the pre-

* "Frühjahrsperiode des Ahorns," Pringsheim's Jahrb. vii. p. 261.